

## SOLAR ENERGY COLLECTOR FOR HOT WATER

### BACKGROUND AND SUMMARY

Presently, most solar collectors for hot water heating in residential and industrial applications include rigid frames (usually metal) with a conductive absorber plate having attached fluid conduits or a double plate absorber having internal fluid passages, plus glazing, gaskets, etc. to enclose the absorber within the frame.

Flat plate collectors have the inherent ability to absorb indirect solar rays, for example during partially cloudy weather or days with thin cirrus type clouds, and are usually installed in arrays on rooftops with fixed slopes, or on framework with fixed slopes mounted on flat roofs of commercial buildings and factories. When arrays are mounted at ground level, fixed slopes are used.

For low temperature fluid heating, parabolic concentrating collectors are not preferred since they require direct sunlight and changes in the mounting angle to keep solar rays focused on the fluid absorber pipe due to seasonal changes in the solar angle.

Primarily because of weight, flat plate collectors are installed with fixed slope ..

For higher solar insolation, frames to adjust for angular orientation and its beneficial effect on the amount of solar heat collected are well known, but present practice avoids adjustable framework for flat plate or concentrating designs at the expense of higher system efficiency.

This invention addresses reasons the prime reason for avoiding adjustable frames, etc., by using lightweight, inexpensive corrugated

paperboard materials and folding techniques to construct a concentrating collector suitable for mounting multiple collector panels in arrays that are pivotable and isolated from building surfaces.

The instant collector defines conduit arrangements that minimize external conduit connections all in the quest for lower panel and system installation costs to make solar heat more competitive with conventional fuels for heating water.

Prior art, U. S. patent 4,190,037 describes use of corrugated material for reflector surface supports but fails to anticipate use and folding of extended side panels to provide positioning and retention means for the supports. Patent '037 also describes fluid manifolds for only parallel flow but does not anticipate the unique advantages of absorber pipe connections for serial flow and the reduction in number of couplings needed to complete an array while the frame is still adjustable.

The instant collector relies on the same operating principles as '037 and is an improvement thereof by defining a fabricated blank that folds into a collector panel having integral inside walls with vertical slots that locate and retain the parabolic supports and thus eliminates the separately molded frames and the additional components required by '037.

With the above and other objectives in view, more information and understanding of the invention and its use for supplemental heating of fluids may be achieved by reference to the detailed description hereinafter.

## BRIEF DESCRIPTION OF THE DRAWINGS

Fig 1 is a plan view of the instant collector with portions removed illustrating construction of the container 'tray', secondary side panel folds with slots for containment of parabolic shaped reflector supports and conduits extending from each end for interconnection between conduits in adjacent reflectors .

Fig. 2 is a sectional side elevation with central portions removed and viewed from 2-2 of Fig 1 illustrating corner folded end panel tabs to connect end and side panels, inside folded side panel extenions with parabolic support containment slots. Reflector surface not shown.

Fig 3 is a sectional end elevation viewed from 3-3 of Fig 1 illustrating placement and containmenr of parabolic shaped support ends within slots in projections of the inside folded secondary side panel.

Fig 4 is a top perspective view of a collector corner illustrating folded tab ends for attaching ends and sides, inside panel folds, slots for supports, and a reflector surface.

Fig 5 is a plan view of an unfolded corrugated blank illustrating fabrication of cutouts, slots, score lines for folding, and apertures for conduit entry-exit.

Fig 6 is an enlarged section of one side panel similar to Fig 3 illustrating foldover of a co-extensive secondary side panel for support containment.

Fig 7 is an enlarged section of one side panel similar to Fig 3 illustrating use of a separately fabricated secondary panel with a folded projection for reflector support slots.

Fig 8 is a simplified plan view illustrating external conduit connections for serial fluid flow within a single collector. Conduits penetrate through film overwrap (not shown) and end panel apertures

Fig 9 is a simplified side elevation of a framework for a collector array illustrating pivotable mounting to adjust for seasonal change in solar angles.

Fig 10 is a plan view of a collector array illustrating use of extended length conduits as absorbers for a plurality of end to end mounted collectors using minimum external conduit connectors for an array.

## DETAILED DESCRIPTION OF THE INVENTION

In Fig 1, solar collector panel 1 consists of a frame having a bottom surface 3, end panels 4, 4', side panels 5, 5' and in the preferred embodiment, inwardly folded side panel extensions (10,10') (see Fig 6).

In Fig 1, parabolic supports 6 ( see Figs3, 5) support reflector surface 7 (shown cutaway on the left side) and are held in slot cutouts 13 in the inside folded side panels 10,10'. Reflector surface 7 is bonded to an insulating substrate 17 (see Fig 3) and focuses solar rays to absorbing collector conduit 8.

In Fig. 1, surface 7 extends between the inside folded panels 10,10' and substantially between end panels 4, 4'.

In Fig 2, the third slot 13 is shown without the support 6 to define its shape and length, noting that the upper slot end is above score / fold line L 4 and the bottom end is below score / fold line L7 to insure that ends of support 6 butt against surfaces of panels 10,10'.

In Fig 3, absorber conduits 8 passes thru apertures 11 in the end panels. Vertical supports 6 with a parabolic shape14 on the upper margin are held in slots 13 cut out from side projections 12 and support substrate 17 and superposed reflector surface 7.

In Fig. 4, cutaway supports 6 are shown without the substrate and reflector surface for clarity. Slots 13 are shown spaced from support 6 to illustrate cut out above upper fold line L4 and below lower line L7.

In practice slots 13 butt against support side surfaces without space.

In Fig 4, inside folded panel 10 is scored and folded to define projections 12 containing support containment slots 13 (see Figs 6,7).

In Fig 5, a corrugated paperboard rectangular blank is fabricated with scored fold lines L1- L1' for end panels 4, 4', scored fold lines L2-L2' for primary side panels 5 - 5', and L3 -L3' for secondary (extended) side panels 10, 10'.

In Fig 5, co-extended panels 10.10' are shorter than inside panel length to avoid interference with end panel 'tabs' 15,15' which are folded inside at the corners. Leaving uncut space at the ends of panels 10.10', the first and last slots are therefore spaced from inside panel ends and the reflector substrate and surface are cantilivered between first and last supports and the respective end panels.

In enlarged Fig 6, the preferred arrangement shows the overfolded panel 10. upper fold line L 4, top score / fold line L5 and L6 for projection 12, and lower fold line L7 to bring the bottom of panel 10 into surface contact with, and attachment to, primary side panel 5. Upper slot cut line 13 and lower cut line 13' (as described above) are shown phantom.

In another embodiment of Fig 7, a separate corrugated piece is scored and folded with projections 12 and attached to an intermediate separately processed corrugated piece (not referenced) to allow a different assembly procedure versus the overfolds of panel 10 described above.

In Fig 8, collector panels 1 are arranged serially as an array with panels P1, P2, and P3. In this instance, connections 18 between adjacent conduits in a panel are external and in the example shown require 6 connectors between and at the ends of a 3 panel collector array.

In Fig 9, a typical framework 19 for an array is rotatably mounted at pivot 20 and includes means 21 to change the framework angle for seasonal change in the solar angle. Arranged as shown in 9, solar panels require 17 external connections for serial flow through the array.

In Fig 10, conduits having a length for three panels long are serially connected at ends 18 to an adjacent conduit for an adjacent parabolic reflector surface, with eight (8) connectors used to connect longer conduits at the ends and at the inlet and outlet versus the 17 connectors are used for an equivalent 9 panel array involving three arrays shown in Fig. 8.

This material saving and lower assembly requirements lower system costs for supplemental solar hot water heating.

It is understood that the present invention may be embodied in other specific forms without departing from the spirit or special attributes hereof, and it is, therefore, desired that the present embodiments be considered in all aspects as illustrative and therefore not restrictive, reference being made to the foregoing description to indicate the scope of the invention.

Having thus described my invention, what I claim as new and desire to protect by Letters Patent are the following: